

CLAIMS

1. A spread code assigning method, in a code spread radio communication system including a first radio transmission device provided with a transmitter for transmitting different first through Mth code spread transmission signals from each of M (M is an integer of 2 or more) transmission antennas, and a second radio transmission device provided with a receiver for receiving and demodulating the first through Mth code spread transmission signals through N (N is an integer of 1 or more) reception antennas, for assigning spread codes to each of the transmission antennas, comprising:
 - calculating a correlation value of each of the propagation paths between the transmission antennas and the reception antennas;
 - assigning, to the ith (i is an integer of 1 or more and M or less) transmission antenna having a propagation path of a correlation value exceeding a predetermined threshold value, only spread codes orthogonal to the spread codes of the jth (j is an integer of 1 or more and M or less, i ≠ j) transmission antenna corresponding to the correlation value; and
 - assigning, to a transmission antenna having no propagation path of a correlation value exceeding the threshold value, spread codes without considering orthogonality to spread codes in the other transmission antennas.
2. A spread code assigning method, in a code spread radio communication system including a first radio transmission device provided with a transmitter for transmitting different first through Mth code spread transmission signals from each of M (M is an integer of 2 or more) transmission antennas, and a second radio transmission device provided with a receiver for receiving and demodulating the first through Mth code spread transmission signals through N (N is an integer of 1 or more) reception

antennas, for assigning spread codes to each of the transmission antennas, comprising:

calculating a correlation value of each of the propagation paths between the transmission antennas and the reception antennas;

5 preferentially assigning, to the ith (i is an integer of 1 or more and M or less) transmission antenna having a propagation path of a correlation value exceeding a predetermined threshold value, spread codes having a small cross correlation value to spread codes of the jth (j is an integer of 1 or more and M or less, $i \neq j$) transmission antenna corresponding to the correlation value, and

10 assigning, to a transmission antenna having no propagation path of a correlation value exceeding the threshold value, spread codes without considering orthogonality to spread codes in the other transmission antennas.

3. The spread code assigning method as claimed in claim 2, wherein
15 spread codes having a small cross correlation value to the spread codes of the jth transmission antenna are spread codes orthogonal to the spread codes of the jth transmission antenna.

4. The spread code assigning method as claimed in claim 2 or 3,
wherein a standard correlation value is calculated based on each of the
20 correlation values of the propagation paths between the M transmission
antennas and the N reception antennas, and in the case that for preset L
threshold values of $x_0, x_1, \dots, x_{(L-1)}$ ($0 \leq x_0 \leq x_1 \leq \dots \leq x_{(L-1)} \leq 1$), the standard
correlation value is x_p or more and below $x_{(p+1)}$ (p is an integer of 0 or more
and $(L-1)$ or less), a code multiplex number for the transmission antenna
25 corresponding to the standard correlation value is set to be $(L-p)$.

5. The spread code assigning method as claimed in any one of claims
1 through 3, wherein a correlation value compared with the threshold value is
a standard correlation value calculated based on a cross correlation value of

each of the propagation paths between the M transmission antennas and the N reception antennas.

6. The spread code assigning method as claimed in claim 4, wherein
the standard correlation value is the maximum value among the $(M-1) \times N$
correlation values obtained by calculating correlation values of a propagation
path between the ith transmission antenna and the kth (k is an integer of 1 or
more and N or less) reception antenna with propagation paths between the
first, second, ..., (i-1)th, (i+1)th, ..., Mth transmission antennas and the kth
reception antenna for the entire reception antennas.

10 7. The spread code assigning method as claimed in claim 5, wherein
the standard correlation value is the maximum value among the $(M-1) \times N$
correlation values obtained by calculating correlation values of a propagation
path between the ith transmission antenna and the kth (k is an integer of 1 or
more and N or less) reception antenna with propagation paths between the
15 first, second, ..., (i-1)th, (i+1)th, ..., Mth transmission antennas and the kth
reception antenna for the entire reception antennas.

8. The spread code assigning method as claimed in claim 4, wherein
the standard correlation value is an average value among the $(M-1) \times N$
correlation values obtained by calculating correlation values of a propagation
path between the ith transmission antenna and the kth (k is an integer of 1 or
more and N or less) reception antenna with propagation paths between the
20 first, second, ..., (i-1)th, (i+1)th, ..., Mth transmission antennas and the kth
reception antenna for the entire reception antennas.

9. The spread code assigning method as claimed in claim 5, wherein
25 the standard correlation value is an average value among the $(M-1) \times N$
correlation values obtained by calculating correlation values of a propagation
path between the ith transmission antenna and the kth (k is an integer of 1 or
more and N or less) reception antenna with propagation paths between the

first, second, ..., (i-1)th, (i+1)th, ..., Mth transmission antennas and the kth reception antenna for the entire reception antennas.

10. A spread code assigning method, in a code spread radio communication system including a first radio transmission device provided
5 with a transmitter for transmitting different first through Mth code spread transmission signals from each of M (M is an integer of 2 or more) transmission antennas, and a second radio transmission device provided with a receiver for receiving and demodulating the first through Mth code spread transmission signals through N (N is an integer of 1 or more) reception
10 antennas, for assigning spread codes to each of the transmission antennas comprising:

detecting a reception quality at a time when each of said code spread transmission signals is received;

15 reducing, in the case that the detected reception quality is below an object minimum value, a maximum value of number of the spread codes assigned to the transmission antenna corresponding to the reception quality, and

20 increasing, in the case that the detected reception quality exceeds an object maximum value, the maximum value of the number of spread codes assigned to the transmission antenna corresponding to the reception quality.

11. The spread code assigning method as claimed in claim 10,
wherein as the reception quality, any of a packet success rate, a signal to interference signal power ratio, and a bit error rate is used.

25 12. The spread code assigning method as claimed in claim 10 or 11,
wherein a priority order of assigned spread codes is set for each transmission antenna, and in the case that the maximum value of the number of the spread codes assigned to each transmission antenna is relatively small, different spread codes orthogonal to each other are assigned to each of the

transmission antennas.

13. A code spread radio communication system including a first radio transmission device provided with a transmitter for transmitting different first through Mth code spread transmission signals from each of M (M is an integer of 2 or more) transmission antennas, and a second radio transmission device provided with a receiver for receiving and demodulating the first through Mth code spread transmission signals through N (N is an integer of 1 or more) reception antennas,

wherein the receiver is provided with a correlation value estimation unit for calculating a correlation value of each propagation path between each of the transmission antennas and each of the reception antennas and transmitting the calculated result as propagation path correlation information,

wherein the transmitter is provided with a spread code assigning unit, and

wherein the spread code assigning unit, based on the propagation path correlation information, assigns, to the ith (i is an integer of 1 or more and M or less) transmission antenna having a propagation path of a correlation value exceeding a predetermined threshold value, only spread codes orthogonal to the spread codes of the jth (j is an integer of 1 or more and M or less, i ≠ j) transmission antenna corresponding to the correlation value, and assigns, to a transmission antenna having no propagation path of a correlation value exceeding the threshold value, spread codes without considering orthogonality to spread codes in the other transmission antennas.

14. The code spread radio communication system as claimed in claim 13, wherein the spread code assigning unit preferentially assigns, based on the propagation path correlation information, to the ith (i is an integer of 1 or more and M or less) transmission antenna having a propagation path of a correlation value exceeding a predetermined threshold value, spread codes

having a small cross correlation value to the spread codes of the jth (j is an integer of 1 or more and M or less, i≠j) transmission antenna corresponding to the correlation value, and assigns, to a transmission antenna having no propagation path of a correlation value exceeding the threshold value, spread codes without considering orthogonality to spread codes in the other transmission antennas.

5 15. The code spread radio communication system as claimed in claim 14, wherein the spread codes having a small cross correlation value to the spread codes of the jth transmission antenna are spread codes orthogonal to the spread codes of the jth transmission antenna.

10 16. A code spread radio communication system including a first radio transmission device provided with a transmitter for transmitting different first through Mth code spread transmission signals from each of M (M is an integer of 2 or more) transmission antennas, and a second radio transmission device provided with a receiver for receiving and demodulating the first through Mth code spread transmission signals with N (N is an integer of 1 or more) reception antennas, wherein

15 the receiver is provided with a reception quality detection unit for detecting reception quality at a time when each of the code spread transmission signals is received and a code multiplex number control signal generating unit, the code multiplex number control signal generating unit, in the case that the reception quality is below an object minimum value, transmitting the code multiplex number control information indicating decreasing of the maximum value of the number of spread codes assigned to the transmission antenna corresponding to the concerned reception quality, and also, in the case that the reception quality exceeds an object maximum value, transmitting the code multiplex number control information indicating increasing of the maximum value of the number of spread codes assigned to

the transmission antenna corresponding to the concerned reception quality,
and wherein

the transmitter is provided with a spread code assigning unit for
assigning spread codes to each of the transmission antenna based on the
5 code multiplex number control information.

17. The code spread radio communication system as claimed in claim
16, wherein the reception quality is any of a packet success rate, a signal to
interference signal power ratio, and a bit error rate.